

BRAC University

Green Power/ Energy Harvesting from Wastage Energy of Human Muscle Activities

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Abstract

As a developing country ours one is not like others, concerning electricity problems. The main issue with the point of view of electrical energy and its sources is lack of generation of electricity. It is happening because of our limitation of technology in the field of electricity. Though renewable energy is introduced, the impact of this new technology is not significant. This is why we are concern on electricity harvesting through human wastage energy. We will use pressure energy to harvest electricity by introducing a mechanism. This pressure energy is taken from the movement of human body. Actually we are trying to introduce such a mechanism through which the electricity problem of Bangladesh will be reduced significantly. The process of acquiring the energy surrounding a system and converting it into usable electrical energy is termed power harvesting. In the last few years, there has been a surge of research in the area of power harvesting. This increase in research has been brought on by the modern advances in wireless technology and low-power electronics such as micro-electromechanical systems. The advances have allowed numerous doors to open for power harvesting systems in practical real-world applications. The use of piezoelectric materials to capitalize on the ambient vibrations surrounding a system is one method that has seen a dramatic rise in use for power harvesting. Piezoelectric materials have a crystalline structure that provides them with the ability to transform mechanical strain energy into electrical charge and, vice versa, to convert an applied electrical potential into mechanical strain. This property provides these materials with the ability to absorb mechanical energy from their surroundings, usually ambient vibration, and transform it into electrical energy that can be used to power other devices. While piezoelectric materials are the major method of harvesting energy, other methods do exist; for example, one of the conventional methods is the use of electromagnetic devices. In this paper we discuss the research that has been performed in the area of power harvesting and the future goals that must be achieved for power harvesting systems to find their way into everyday use. On our project we will be trying to do this combination to harvest more energy.

APPROVAL

The Thesis Report “Green Power Harvesting from Wastage Energy of Human Muscle Activities” submitted by Palash Dhar and Ajjijul Hakim Khandakar to the Department of Electrical and Electronics Engineering, BRAC University Bangladesh, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of Bachelor of Science (Hons) in Electrical and Electronics Engineering and approved as to its style and contents.

(Dr. Md. Khalilur Rhaman)

Supervisor

Declaration

We, hereby, declare that the work presented in this Thesis Project is the outcome of the investigation performed by us under the supervision of **Dr. Md. KhalilurRhaman**, Assistant Professor of Department of Computer Science and Engineering, as Supervisor and **Ms. Farzana Shabnam** as Co-advisor, Lecture of Department of Electrical and Electronics Engineering, BRAC University Bangladesh. We also declare that this is our original work and was not submitted elsewhere for the award of any other degree or any other publication.

Date: 27/04/2013

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1. Introduction

There is an increasing level of research activity in the area of alternative power sources for MEMS devices with the terms ‘energy harvesting’ and ‘parasitic power sources’ being adopted. A recent review of wireless sensors, covering the area of energy harvesting, indicated the following current areas of research:

- Solar
- Vibration
- Temperature difference
- Electromagnetic fields
- Chemical.

Typical application areas for ‘self powered’ intelligent sensor systems are:

- Inside the body (e.g. human, animal)
- On rotating objects
- Within liquids such as molten plastic or setting concrete
- Structural monitoring such as within bridges, buildings, aircraft or roads
- Environmental monitoring such as pollution monitoring in fields.

1.1. Motivation

Extensive use of fossil fuels as an energy source for both sea and land based transport leads to significant amounts of CO₂ and other pollutants being produced. Much research, particularly within the automotive industry, is being undertaken to develop more environmental friendly fuel chains, and the fuel cell vehicle stands out as a promising technology for the future. This paper describes research at the BRAC University of Bangladesh on an electromagnetic generator, Piezoelectric and motors targeted at harvesting useful electrical power from ambient vibrations and waste energy from human. We basically create a cycling generator, a mechanical design of one way rotation which can be fixed with chair or door, and work with piezoelectric material.

1.2. Summary of following Chapter

In the following chapters we are discussing about, research background, impact, how and what logic we used to construct our instrument machine to generate electricity. Then we discussed the datasheet we collect from the machine and their graphical representation and our

assumption. We also discuss about the lacking and the problems of the machines that we constructs.

2. Research and Proposal

2.1. Research Background

Numerous studies have been conducted on various facts of Energy Harvesting, focusing on the Green energy but all these studies are not applied in Bangladesh. The ultimate result is, Bangladesh is still suffering from lack of electrical power. In the field of power harvesting, Piezoelectric material which produces electricity through a mechanism, is unable to play significant role on the perspective of Bangladesh. A lot of researches are done along with proposal on this issue. For example “Electric power harvesting using piezoelectric materials” by Henry A. Sodano, Gyuhae Park, Donald J. Leo, Daniel J. Inman, shows piezoelectric material can be used as mechanisms to transfer ambient vibrations into electrical energy. This also shows the performance and ability of to store electrical power by hybrid batteries. Some works are done on pressure through which electricity is produced. Concerning a huge field of pressure in Bangladesh we decide to work on the energy harvesting from human wastage muscle activity. Though some western countries have already done a lot of works on electricity from pressure, they were concern on chemically build up materials. A few significant works on harvesting are “Parasitic Power Harvesting in Shoes” by Physics and Media Group, MIT Media Laboratory; “Energy harvesting from automotive applications” By Dr Harry Zervos, Technology Analyst. These papers are not concerning on mechanical process by which pressure can be converted into electricity. The sources are lying and sitting activity on chair, opening and closing gates even vibration of machine, oscillating motion of our body and so on.

2.2. Proposal

We have studied that pressure energy can be used for electricity harvesting through a mechanical technique. The main concern of our work is to build up a mechanism. That’s why we introduce two mechanisms considering the sources Pressure from Chair, Cycling instruments of any type and Piezoelectric material.

2.2.1. Chair

The backward pressure of chair is converted into circular motion through gear train. That circular motion which is taken from pressure will be geared and applied to the rotor to rotate the mini generator. By this rotation we will be able to produce electricity. We can implement this mechanism into huge area like cafeteria of universities, reception room of any office and shopping mall. We are expecting that we will be able to maintain the demand of electricity of at least one floor of any multi-storied complex.

2.2.2. Cycling

In the gymnasium there are different kinds of exercise equipment are used through human muscular pressure. From many types of equipment we have decided to work with cycling machine. In the cycling machine there is a gear for increasing the pressure. In the paddle there will be two gears where one is connected to the main cycling machine and another will rotate as the pressure given. The generator rotor is connected to the second gear. From there, the same mechanism will be used to increase the rotation of the generator. From this mechanism we will be able to produce enough electricity.

Using piezoelectric material: Piezoelectric material is the new product which is used to produce electricity from pressure. If we can make such a carpet and use in the shopping mall, school, college, university and public place where people walk significantly, to produce electricity.

2.3. Physical Equipment:

2.3.1. Physical Equipment of Cycling

We have worked with cycling machine. This machine is mainly used for decreasing the fat of human body. The user moves his/her legs through cycling the paddle of the machine. The incident force on the paddle is transferred to the load of the system. The load resists the incident force by some mechanical appliances. Since this is possible to use the incident force for some other applications instead of resisting it. Therefore we concern on driving a dynamo by using this

force. This is possible when the system gets enough energy to achieve the desired rotation per minute (rpm).

2.3.2. Physical Equipment of Chair

We will use backward pressure applied on the chair and the release of that pressure by user in this mechanism. This backward force or pressure will insist the linear gear system to rotate the circular pinion half through a ball joined at the edge of linear gear system. Then the release pressure will insist the linear gear system to rotate the circular pinion left half to complete the full one cycle circulation. Thus the system will continue and will be connected to a mini alternator which will induce required voltage for electrical appliances.

2.4. System Description:

2.4.1. System Description of Cycling

Our physical energy is converted to electrical energy through a cycling machine connected with a dynamo. Here we have used the dynamo of a 100cc car which is active for 12v at minimum. As we previously concerned that rotation per minute (rpm) of rotor of the dynamo is most important for our mechanism, we used three gears in the machine. These gears are connected to the rotor of the dynamo. When the users apply the impulse force on the paddle the machine will start and user have to gradually increase pressurized force to meet the desired rotation per minute (rpm). Then the applied force accelerates the gears which will ultimately results in circulation of the rotor of the dynamo. By this rotation magnetic field will induce inside the core of the dynamo. From Curl's equation it is known that changing magnetic field results in changing electric field. As a result an electric field will introduce in the dynamo which ends up with induction of voltage through the connection of electrical appliances.

2.4.2. System Description of Chair

The chair used for this mechanism is normally have spring below the seat. This spring usually help the user to move front or back from the seat. A 30 inch long, $\frac{1}{2}$ inch width and $\frac{1}{2}$ inch thickness of metal sheet is used as linear gear system. Among the 30 inch length of metal sheet

24 inch is designed with minimum of 100 teeth. This metal sheet is placed in such a way that it moves along the movement of the user. The rotor of a DC dynamo is placed on the teeth of the linear gear. Therefore with the movement of the user the rotor rotates. For having maximum efficiency of the system two metal sheets are placed in symmetrical way. A gear is introduced between the sheets and rotor to get one way circulation. Thus from the rotation of the rotor dynamo induce voltage which will be used through electrical circuit for charging any device.

2.5. Expected Contribution:

In our project we expect that the power of the proposal instrument will following

Chair:	10W
Cycling:	100W
Using piezoelectric material:	10W

This project has to offer a durable product with relatively good efficiency. It has low production cost and high safety. It also helps our country to reduce electricity problems. It also helps to reduce pressure on oil, coal and gas. The most important thing is without CO₂, CFC even not using grid electricity one can perform daily little electric task like mobile charging by cycling or sitting on a chair.

3. Construction of the green power harvesting by cycling

3.1. Instrument

To construct the green power generator by cycling, the following instrument are needed

- i) Gym cycle
- ii) Dynamo of a car (about 16000rpm)
- iii) Some gears
- iv) Chain

In our project we take a dynamo of Maruti-Suzuki, which is rpm is unknown. We also checked Toyota car's of 1600cc motor's dynamo, it is 15,800 rpm. It is too high for a person to rotate. However, we assume that the dynamo of Maruti-Suzuki's rpm is around 9000rpm. Again we also tried with the dynamo of Toyota 1200cc motor's dynamo which is about 10000rpm.

3.2. Description of the dynamo:

The dynamo we select one is, dynamo of Maruti Suzuki car of 800cc. and another is dynamo of Toyota car of 1600cc. We dynamo use both the dynamo in our project for the data sheet. The dynamo uses rotating coils of wire and magnetic fields to convert mechanical rotation into a pulsing direct electric current through Faraday's law of induction. A dynamo machine consists of a stationary structure known as stator, which provides a constant magnetic field, and a set of rotating windings called the armature which turn within that field. The motion of the wire within the magnetic field causes the field to push on the electrons in the metal, creating an electric current in the wire. On small machines the constant magnetic field may be provided

by one or more permanent magnets; larger machines have the constant magnetic field provided by one or more electromagnets, which are usually called *field coils*. However in the car dynamo there no permanent magnet as stator, instead of that there is a coil. To create electric field in the stator we have to flow electricity from a source. After creating the electric field in stator, when rotor rotates we can produce electricity. If we open an alternator we will noticed that it is just composed of three things:

1. Generator – This generate the alternating current
2. Rectifier – Converts the a/c power to d/c
3. Regulator – This regulates the output power so that we could not over charge the battery and the parameters for voltage and current is in range for consumption to avoid damage for the device and the loads, since the acceleration of the engine s always changing. This is accomplished by varying the supply of the field coil by the use of slip rings in the shafting.



Fig 1: Dynamo we used



Fig 2: Regulator assy



Fig 3: Regulator / Rectifier

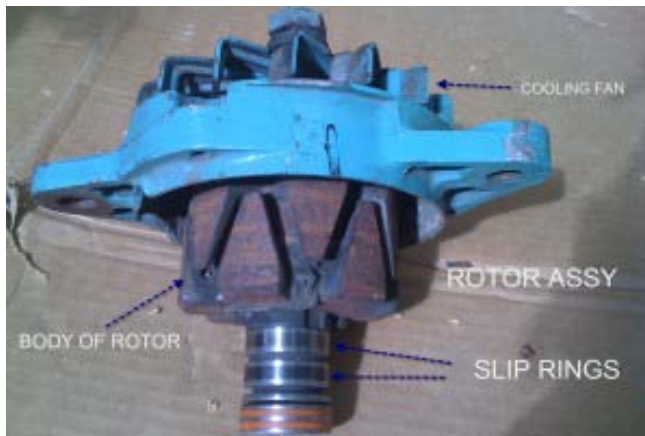


Fig 4: Rotor



Fig 5: Stator

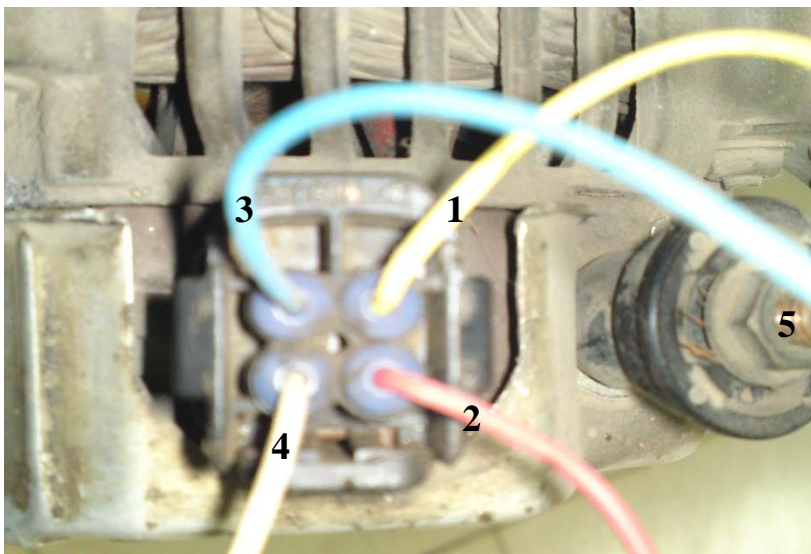


Fig 6: Wire position of the dynamo

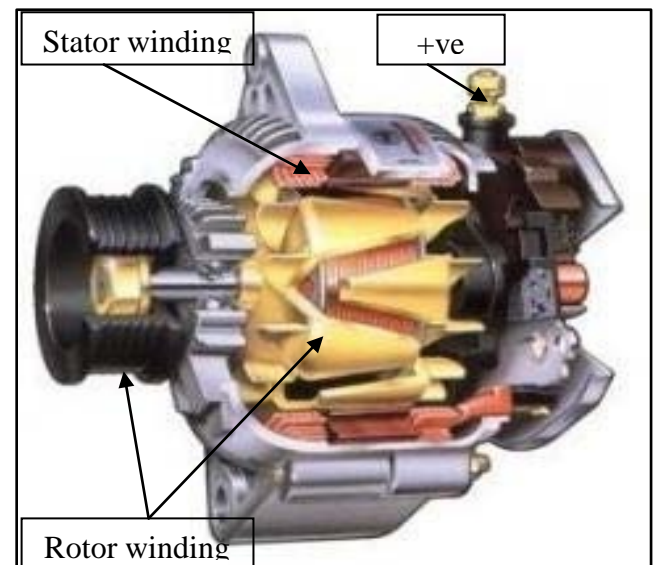


Fig 7: Car Dynamo bisection

In this type of dynamo we will get AC (alternative current) voltage. We cannot store AC voltage directly in the dry cell. To store we have to convert the AC voltage to DC voltage. However, in this type of dynamo we do not need to add any extra converter to convert. In the dynamo there is a Regulator / Rectifier circuit which converts AC voltage to DC voltage, and by proper wire connection we can charge the dry cell.

To connect in the battery wire 1 and 2 must short and connect to position 5 which connect to battery (+ve) point. And ground of the battery is connected to body of the machine. The wire of 3 is used for the charging indicator. And the wire 4 is used for direct connection of device.

From 3rd wire we can examine that the dry cell or battery is charging or not. While the rotor is rotating and the wire is connected properly to the dry cell or battery the bulb of wire three will be

TO POSITIVE BATTERY
CAN BE CONNECTED TO KEY
SW

TO INDICATOR LIGHT

TO BATTERY TERMINAL
POSITIVE

NEGATIVE TERMINAL OR
GROUND

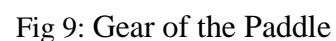
THIS WIRE CHARGES THE
BATTERY WITH CURRENT SO
WE MUST USE BIGGER WIRE
LIKE 5.5 MM SQ

INDICATOR LIGHT
IN THE PANEL

3.3. The construction with the calculation

We construct the machine of green power generator in such a way that our rotation of the dynamo is much closer to their rpm. The calculation of the rotation is given below:

1 rotation of the first free ball or second gear gives 4 rotations to the second free ball



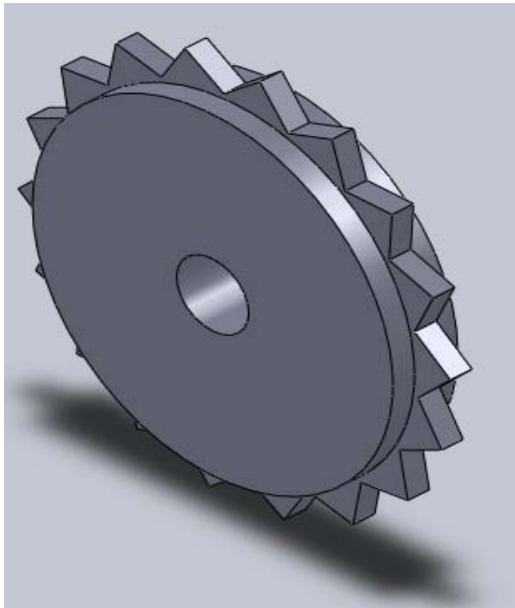


Fig 10: Gear of 18 teeth

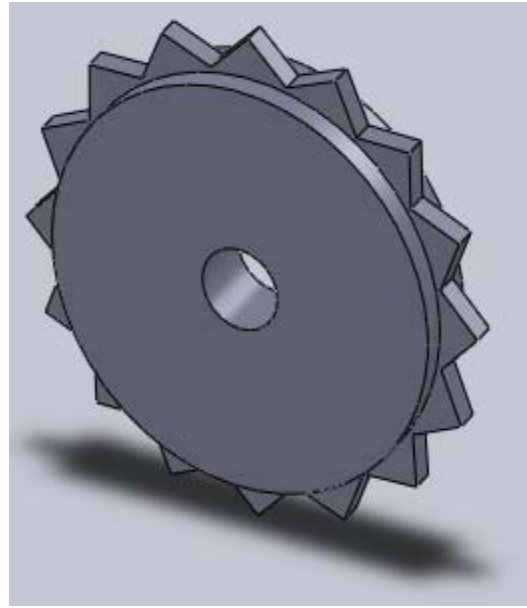


Fig 11: Gear of 16 teeth

Again 1 rotation of free ball as input in of first self gives 5 rotation as output

In the same way 1 rotation of first self (as output) or second self (as input) gives 5 rotations as output

So the total output of the second self in 1 rotation of the first gear or paddle is $3 \times 4 \times 5 \times 5 = 300$ rotation

If a person can rotate the paddle 40 rotation per minutes then the rotation of the dynamo is $300 \times 40 = 12,000$ rpm.

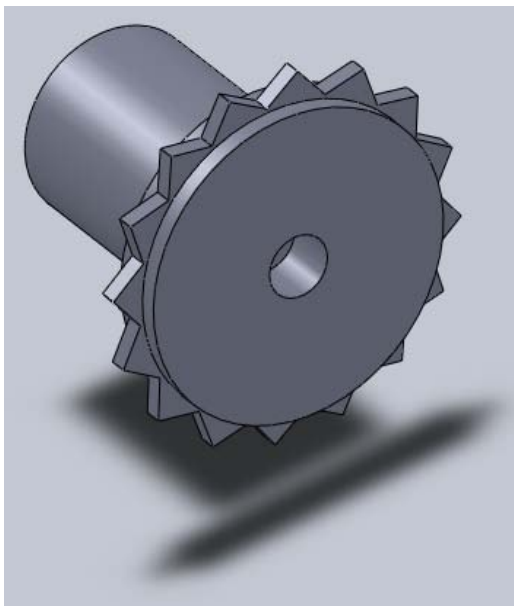


Fig 12: Gear box attached 16 teeth gear

The main mechanical construct of the machine is written below

First of all reconstruct the cycle and open all of the mechanism of the cycle which is already installed. At the beginning we have to take look weather the main paddle or first gear is in the back of the machine or in front of the machine. In our project the first paddle or gear is in the back of the machine. On the other hand we use the first gear which was already installed in the cycle and the number of teeth of the gear is 16. We may used the same gear both first and second gear, if we want to increase the rotation we can change the first gear. So in front of the machine we take a paddle of 25 teeth for second gear and first free ball of 18 teeth attached together so that the first free ball and the

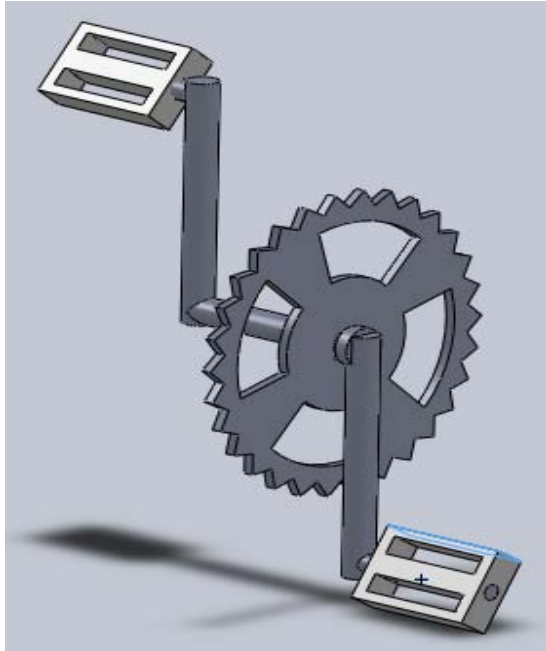


Fig 13: Paddle

second gear rotate in same rotation. We fix the attached gear and free ball at the same distance where the load was installed first. Make sure that the first gear and the first free ball are in same side. To attach the gear one main condition is required that is the first gear and the first free ball must be at same line. Otherwise the chain will overcome the free ball and it will not be used for rotating. With the help of another chain we join second free ball of 16 teeth, from the gear which is attached gear in the same but in the opposite side of the first free ball. And it is putted in front of the first free ball and second gear attachment. Same condition is applied here for second chain; second gear and second free ball are in same line.

We take a self of car which is 5:1 rotation. This will give 5 rotations in 1 rotation. In the output side we fixed the dynamo and in the input side of the self we fixed the second free ball.

In general dynamos rotate in clockwise direction, so we fixed the self and free ball attachment in the left of the machine. Then we put the dynamo of Maruti-Suzuki/Toyota in the left of the self. And we put the dynamo in a frame at flexible height. Then we fixed the frame with the cycle.

In this design the calculation of rotation is given below

A person will rotate the paddle 40-45 rotation per minute

1 rotation in first gear will give 3 rotations in first free ball

1 rotation in first free ball is same in second gear

1 rotation in second gear will give 4 rotations in second free ball

So 1 rotation in first gear will give $3 \times 4 = 12$ rotations in second free ball

Again 1 rotation in second free ball will give 5 rotations in the output of the self or input of the dynamo

So 1 rotation in first gear will give $3 \times 4 \times 5 = 60$

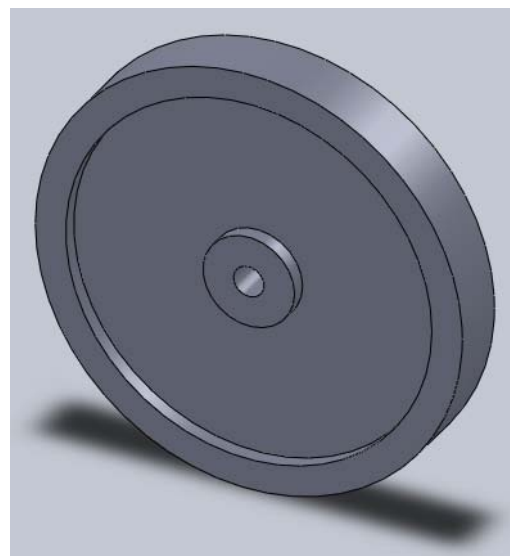


Fig 14: Load for increase inertia

rotations in output of the self or input of the dynamo

So from the calculation we get the rotation of the dynamo per minute is $40 \times 60 = 2400$ rotations

2400rpm is much less than from our consumption.



Fig 15: Gear of 18 teeth that we used



Fig 16: Gear of 16 teeth that we used

For the region of low rotation (no of table) and some other problems (no of problems) we have reconstruct the machine.

In the second design we increase two 5:1 self before the dynamo.

In this design the calculation of rotation is given below

A person will rotate the paddle 40-45 rotation per minute



Fig 17: Gear box attached 16 teeth gear that we used

1 rotation in first gear will give 3 rotations in first free ball

1 rotation in first free ball is same in second gear

1 rotation in second gear will give 4 rotations in second free ball

So 1 rotation in first gear will give $3 \times 4 = 12$ rotations in second free ball

Again 1 rotation in second free ball will give 5 rotations in the output of the self or input of the second self



Fig 18: Paddle that we used

Again 1 rotation in second free ball will give 25 rotations in the output of the self or input of the third self

Again 1 rotation in second free ball will give 125 rotations in the output of the self or input of the dynamo

So 1 rotation in first gear will give $3 \times 4 \times 125 = 1500$ rotations in output of the self or input of the dynamo

So from the calculation we get the rotation of the dynamo per minute is $40 \times 1500 = 60,000$ rotations.

Problems for the construction:

60,000rpm is better for to produce electricity but the rotation is much higher for this machine. When we rotate the machine sometime burning smoke is coming out from the last self of the construction. However, the construction is not applicable for the human, the reason is it is too hard that a human cannot rotate the cycle 40 rotation per minute and he or she cannot rotate more than two minute.

So we reconstruct the machine.

The only change of the third construction is we reduce one 5:1 self from the machine.

In this design the calculation of rotation is given below

A person will rotate the paddle 40-45 rotation per minute

1 rotation in first gear will give 3 rotations in first free ball

1 rotation in first free ball is same in second gear



Fig 19: Load for increase inertia that we used

1 rotation in second gear will give 4 rotations in second free ball

So 1 rotation in first gear will give $3 \times 4 = 12$ rotations in second free ball

Again 1 rotation in second free ball will give 5 rotations in the output of the self or input of the second self

Again 1 rotation in second free ball will give 25 rotations in the output of the self or input of the third self

So 1 rotation in first gear will give $3 \times 4 \times 25 = 300$ rotations in output of the self or input of the dynamo

So from the calculation we get the rotation of the dynamo per minute is $40 \times 300 = 12,000$ rotations.

12,000 rpm is our desirable rotation.

Now we change the very first gear of 25 teeth, which is the same to the second gear.

So the calculation is also change.

A person will rotate the paddle 40-45 rotation per minute

1 rotation in first gear will give 4 rotations in first free ball

1 rotation in first free ball is same in second gear

1 rotation in second gear will give 4 rotations in second free ball

So 1 rotation in first gear will give $4 \times 4 = 16$ rotations in second free ball

Again 1 rotation in second free ball will give 5 rotations in the output of the self or input of the second self

Again 1 rotation in second free ball will give 25 rotations in the output of the self or input of the third self

So 1 rotation in first gear will give $4 \times 4 \times 25 = 400$ rotations in output of the self or input of the dynamo

So from the calculation we get the rotation of the dynamo per minute is $40 \times 400 = 16,000$ rotations.

To increase the inertia of the rotation we install a load of 5 kg in the second gear so that the second gear will rotate for a while human stop paddling or human will become weak.



Fig 20: Connection between paddle1 and gear1



Fig 21: Other side of Load



Fig 22: Gear2



Fig 23: Dynamo connection of self 1:5



Fig 24: Connection between paddle2 and gear2

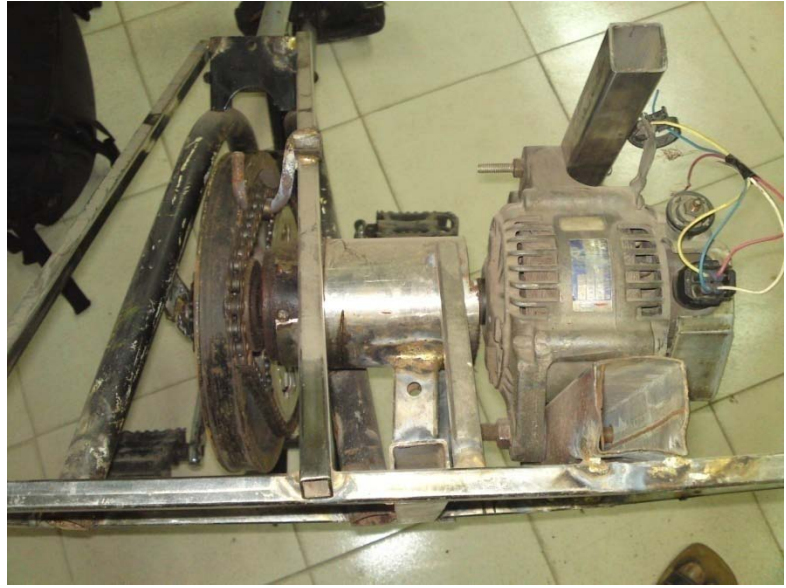


Fig 25: Connection between gear2, 1:5 Self and Dynamo



Fig 26: Right view of the full machine



Fig 27: Left view of the full machine

We can show the whole process in this table of calculation.

Table1: Calculation of construction

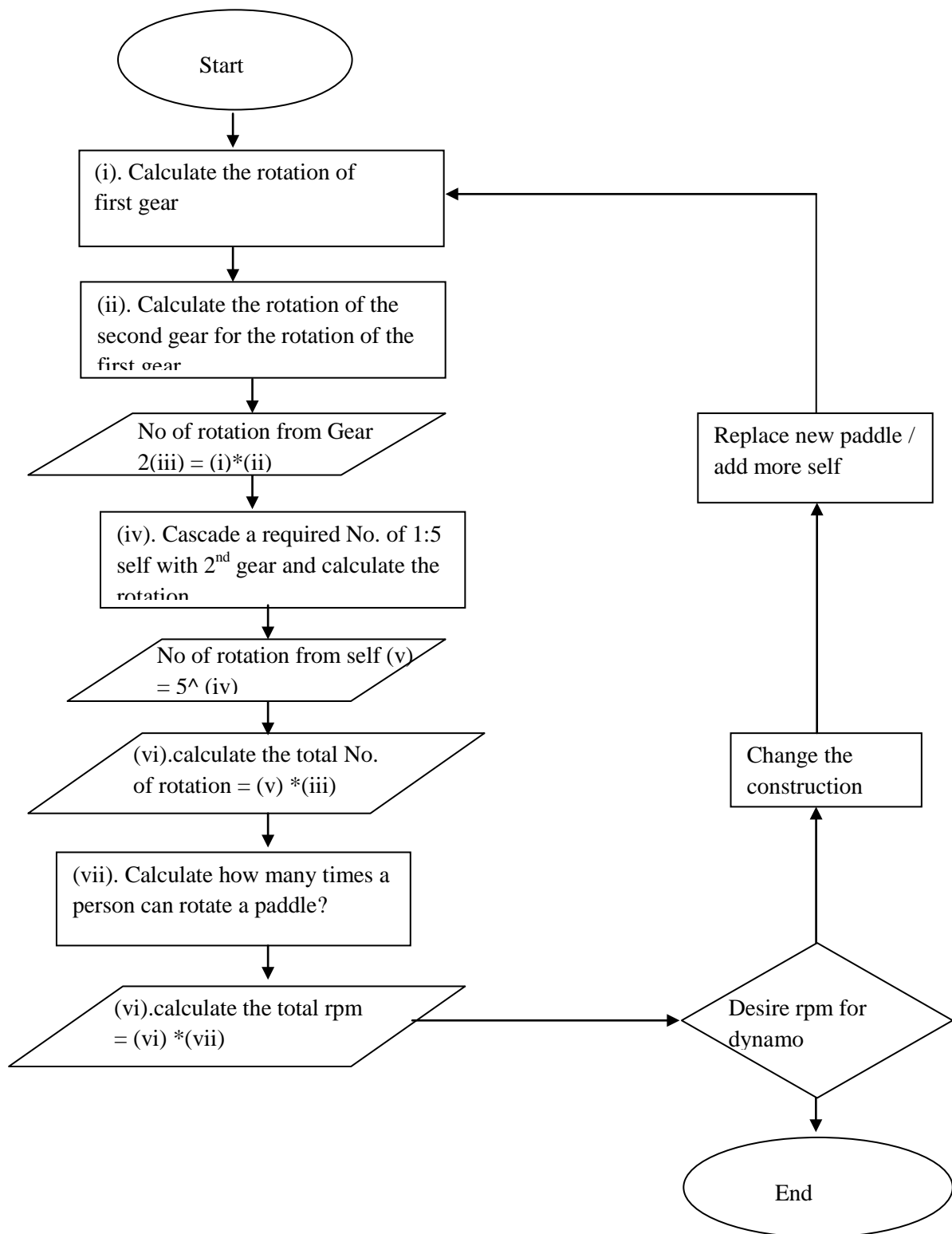
Step	No. of Teeth			No. of Rotation at Free Ball1 due to 1 rotation of Gear (iv)	No. of Rotation at Free Ball2 due to 1 rotation of Free Ball (v)	Total No. of Rotation at Free Ball2 for 1 rotation of Gear $=[(iv)*(v)]$ (a)	No. of 1:5 Self (b)	No. of rotation from self I = $5^{(b)}$	Total No. of Rotation at dynamo rotor for 1 rotation of Gear (d) = $a*b$	Total rpm for the dynamo rpm = $d \times 40$
	Gear (i)	Free Ball 1 (ii)	Free Ball 2 (iii)							
1	25	18	16	3	4	12	2	25	300	12000
2	25	18	16	3	4	12	1	5	60	2400
3	25	18	16	3	4	12	3	125	1500	60000
4	32	18	16	4	4	16	2	25	400	16000

Description of the table:

In the dynamo that we chose need around 16000 rpm, but in the first step we found 12,000 rpm. So we decide to loss some load so that a person can rotate the paddle more frequently and more rotation we came to reach the required rpm. For the reason we remove 1 self and found 2400 - 3000rpm that is too low. So we have to redesign the construction and decide to have 3 1:5 self. After cascade the self we found that the rpm is 60,000. Which is required a huge energy for a person to rotate the paddle. However if anyone can rotate the paddle, after while in the 3rd self the pinion was so hot for the rotation that it burn the plastic portion of the self. So we have to re construct the machine. In the 4th step we change the paddle and set a paddle of 32 teeth so that in the second gear we get 4 rotations and cascade the self we get the required rpm of 16,000.

We can also show the whole process in the flow chart

Fig 28: Flow chart of the cycle generator design



4. Construction of the green power harvesting by chair

4.1. Instruments

To construct the green power generator by chair, the following instrument are needed

- i) Chair(easy chair)
- ii) Dynamo of a bicycle
- iii) Two free ball and some bearing
- iv) Rubber belt or leather belt



Fig 29: Cycle Dynamo which we use

4.2. Description of the dynamo:



Fig 30: Cycle Dynamo set available in market

The dynamo we select is dynamo of the bicycle. The dynamo uses rotating coils of wire and magnetic fields to convert mechanical rotation into a pulsing direct electric current through Faraday's law of induction. A dynamo machine consists of a stationary structure known as stator, which provides a constant magnetic field, and a set of rotating windings called the armature which turn within that field. The motion of the wire within the magnetic field causes

the field to push on the electrons in the metal, creating an electric current in the wire. On small machines the constant magnetic field may be provided by one or more permanent magnets;

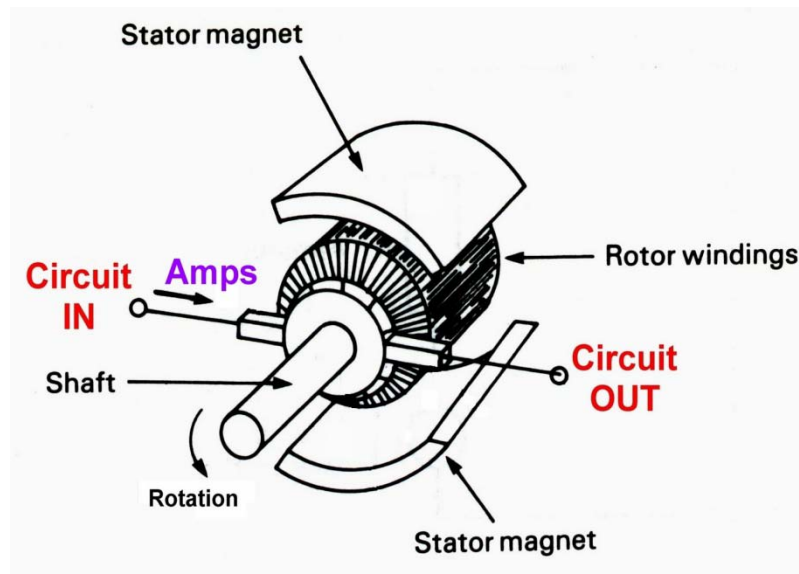


Fig 31: Bisection of Cycle Dynamo

larger machines have the constant magnetic field provided by one or more electromagnets, which are usually called *field coils*. However in the bicycle dynamo there is permanent magnet as stator. To create electric field in the stator we don't have to flow electricity from a source as car dynamo. The reason is, there is permanent magnet in the stator of this dynamo. In this dynamo, if we rotate the rotor of the dynamo we can get the DC electricity from the dynamo.

4.3. The construction

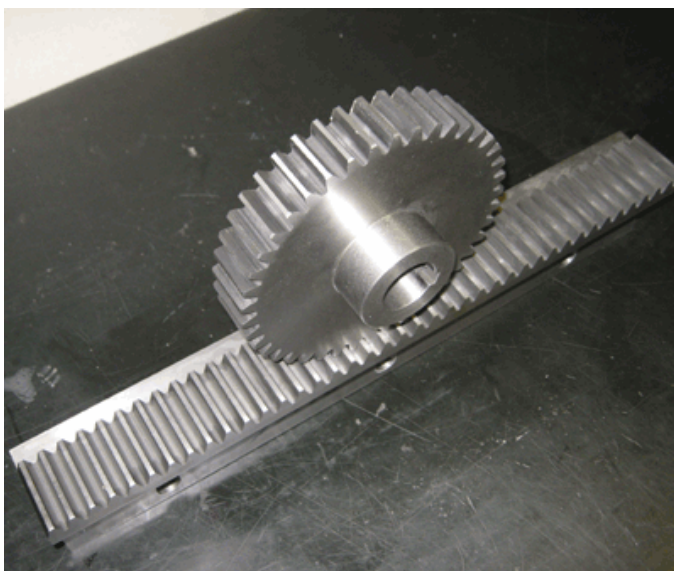


Fig 32: Rack and pinion

To construct the design we made a frame of length 14 inches and width 8 inches, and we use 1 inches by 0.5 inches box pipe to construct the frame. Now we take two free balls of 18 teeth and cut all the teeth to get a round free ball. Then we take a rod of radius 0.25 inches, length 7.5 inches and attached the free balls in opposite direction of rotation. We attached two bearing in the opposite side of the rod.



Fig 33: Rack Pinion connect with the two free ball of different direction of rotation (Upper view)



Fig 34: Rack Pinion connect with the two free ball of different direction of rotation (Bottom view)



Fig 35: Belt1 connection with one way direction of rotation



Fig 36: Belt2 connection with one way direction of rotation



Fig 35: Rotor of one way rotation



Fig 37: Connection with dynamo



Fig 38: Full connection of the belt



Fig 39: Connection of the Dynamo and Load

A rack and pinion is a type of linear actuator that comprises a pair of gears which convert rotational motion into linear motion. The circular pinion engages teeth on a linear “gear” bar—the rack. Rotational motion applied to the pinion will cause the rack to move to the side, up to the limit of its travel. For example, in a rack railway, the rotation of a pinion mounted on a locomotive or a railcar engages a rack between the rails and pulls a train along a steep slope.

The rack and pinion arrangement is commonly found in the steering mechanism of cars or other wheeled, steered vehicles. It is also found in many industrial machines.

We attached a rack and pinion in the middle of the rod, so that when the rack is push front the pinion will rotate and when the rack is pull back the pinion will rotate in opposite direction.

Our main target is to weather the rack is moving (in front or back) our dynamo will rotate in the every state. So we take another same size of rod attached with a SS pipe of 1 inches radius, and attached it in the opposite if the first rod. To reach our goal we take a belt and attached in one side of the rack and pinion to a free ball with the second rod normally, so when the rack push, the first rod will rotate in particular direction. On the other-side we have changed a little bit of set the belt, we set the belt such a way so that the rotation of the second rod/shaft will rotate in same

direction. As a result when the rack push in front or pull in back the second rod will rotate in the same direction. To increase the rotation we set a ring in the middle of the second rod, through whom the rotor of the dynamo will rotate.



Fig 40: Side view of the machine



Fig 41: Side view of the machine

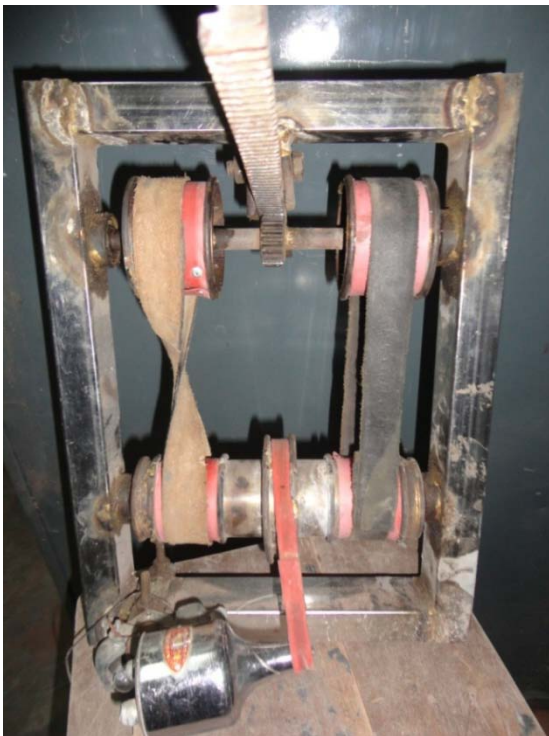


Fig 42: Front view of the machine

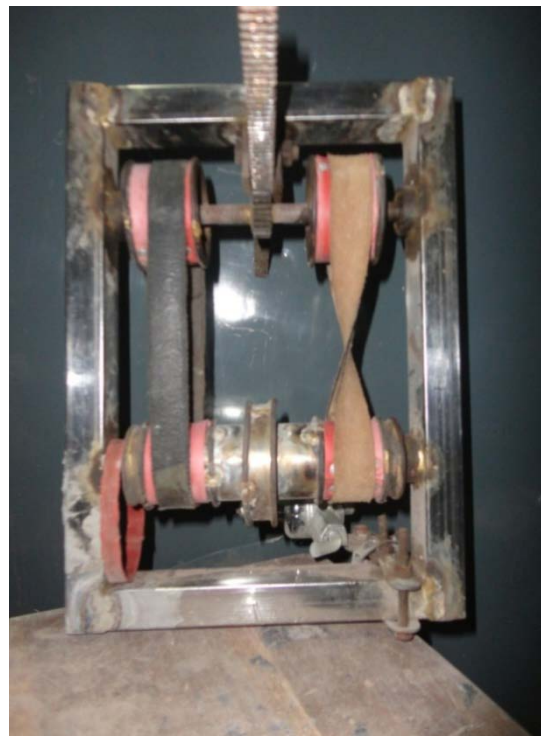


Fig 43: Back view of the machine

5. Data and graphical representation:

5.1. Cycling

Table2: Reading (1)of cycle generator

Sl. No.	Minute in sec.	Rotation /min	Voc
1	23	9665	6.39
2	21	9223	5.91
3	25	7804	4.6
4	24	7465	4.16
5	22	6550	3.22

Graph1: Voc Vs Rotation

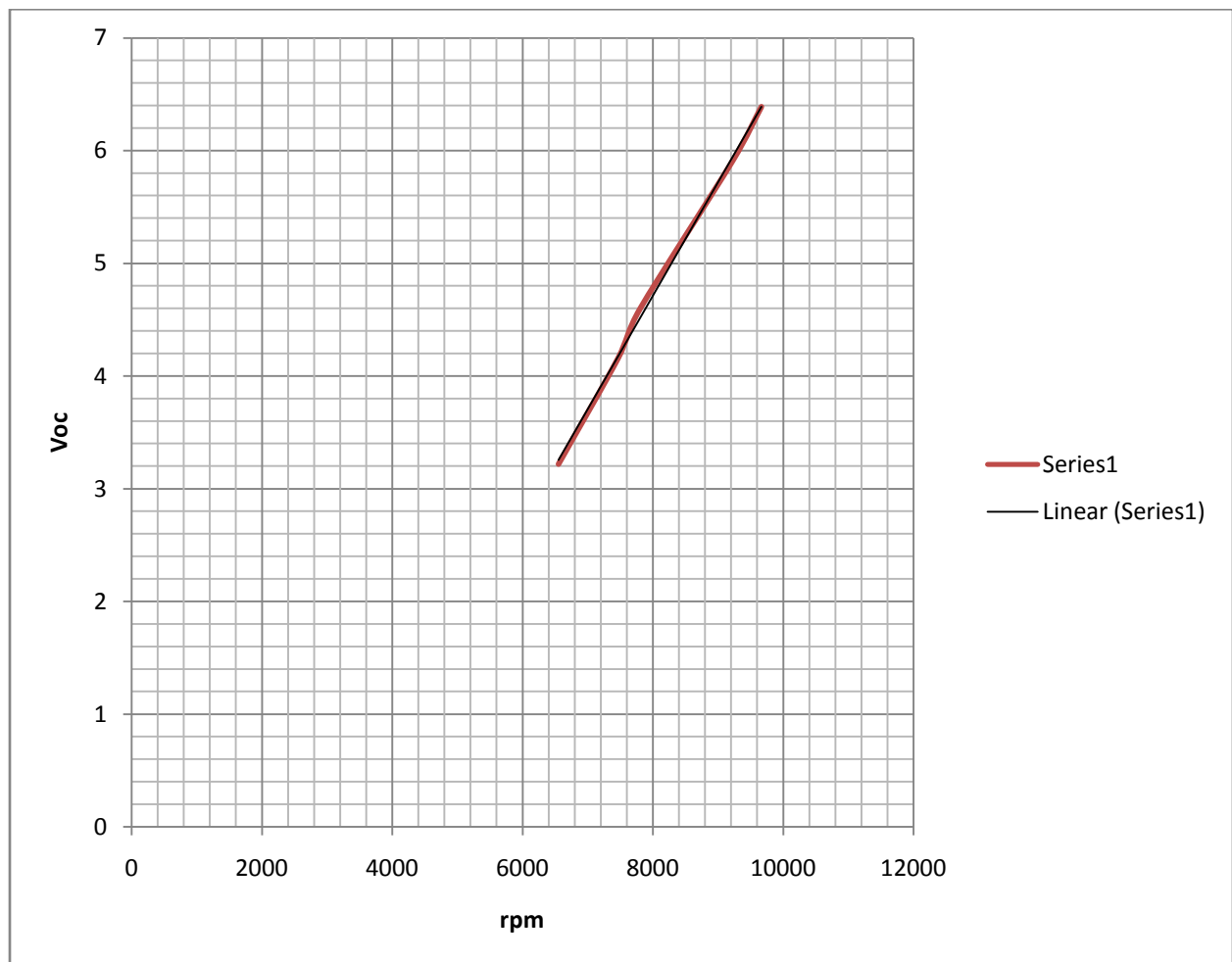


Table3: Reading (2)of cycle generator

Sl. No.	Minute in sec.	Rotation /min	Voc
1	40	12132	8.4
2	32	10302	6.84
3	40	8516	5.25
4	25	8121	4.79
5	20	7335	4.01

Graph2: Voc Vs rpm

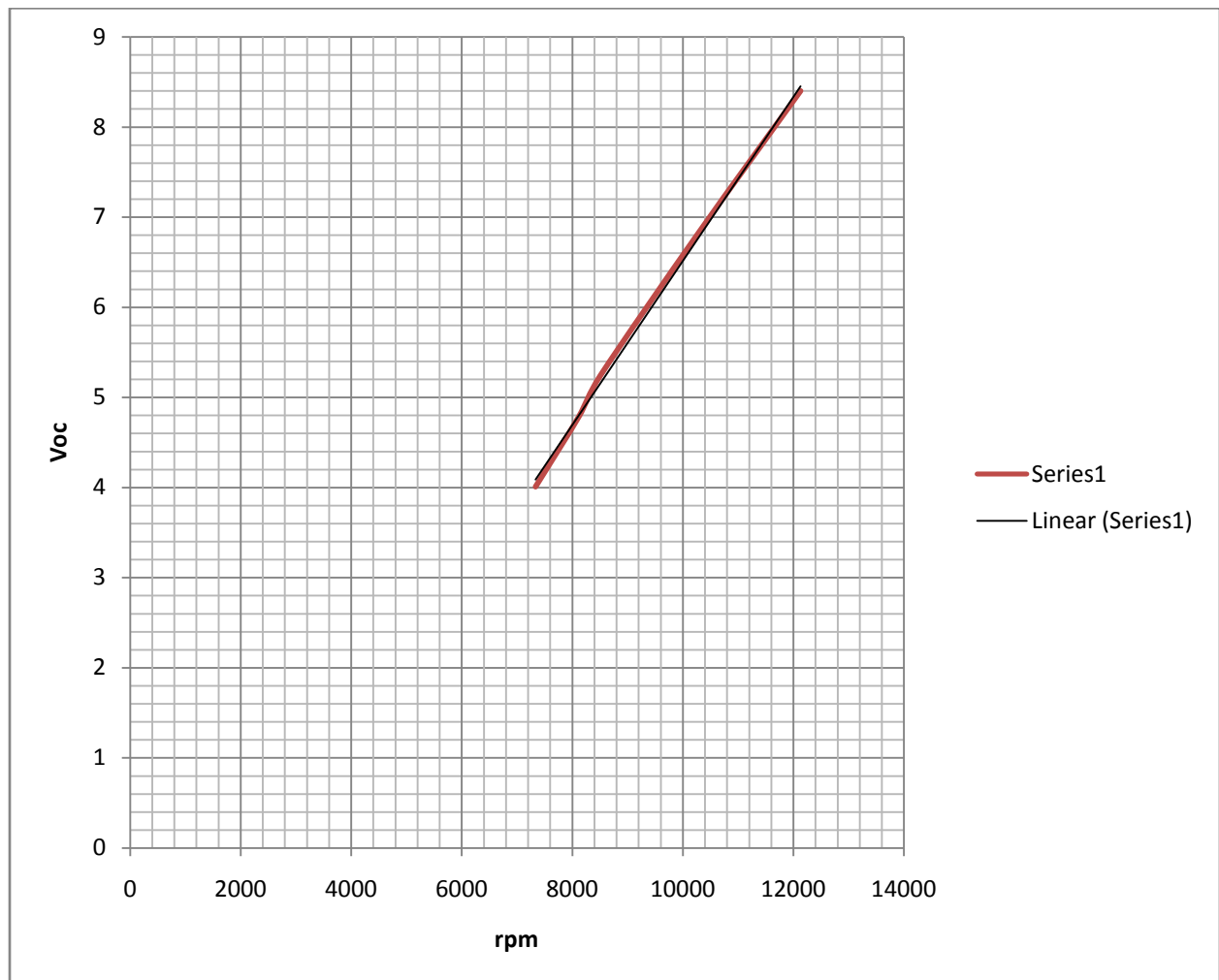
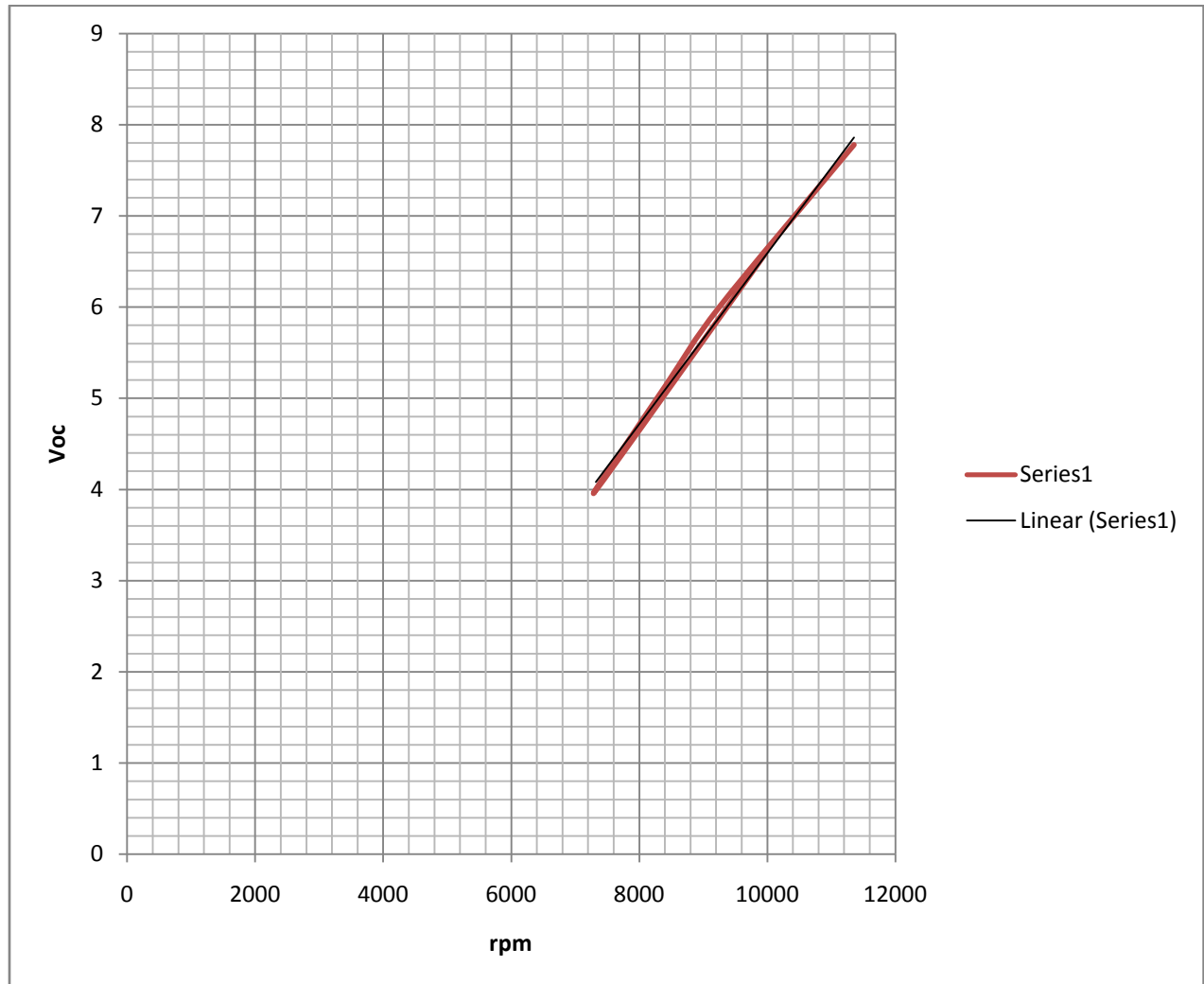


Table4: Reading (3)of cycle generator

Sl. No.	Minute in sec.	Rotation /min	Voc
1	60	11356	7.78
2	48	9262	6.01
3	42	8422	5.15
4	25	7322	3.99
5	20	9964	6.58

Graph1: Voc Vs Rotation



Decision from the data:

From the data we can say that our dynamo is completely dependent on the rotation. Again, the rotation is dependent of the human energy. Means, more a human can rotate the cycle more power is generate from the gym-cycle generator.

5.2. Chair

Table 5: Data from Main machine part of chair generation in different day:

Sl. No.	1 pair of linear motion	Time take for the linear motion	Voltage1
1	10	15	0.8
2	8	15	0.7
3	9	16	0.6
4	10	19	0.6
5	5	16	0.4
6	6	17	0.5
7	7	7	0.8

Decision from the data:

From the data we can say that the voltage is dependent on the rotation of the dynamo in time. Means, more rotation in low time the voltage will increase from the main mechanism of chair generator.

6. Limitations of our Thesis Project:

6.1. In case of Cycling:

6.1.1. Limitations:

In the cycling machine we set the dynamo generator at front side. As a result the bottom line pressure of the chain1 and chain2 connected to rotor of the dynamo through paddle has increased. Though the support of both chains is not so strong, the bottom side of both chain become tight and top side of both chain get more flexibility. As per sequence both chains rotate to clockwise direction and cause two teeth displacement of chain1 for per rotation. For this reason chain1 from top side view in case of rotation become overlapped. For this reason displacement of chain1 happened. This consequence reduces number of rotation and creates sound which is not so comfort to hear.

We have also used dynamo of Maruti and dynamo of Toyota 1600cc cars. In the mean time we found that it is much difficult to paddle the cycling machine connected to the external voltage sources than the machine without connected to any external voltage sources. Since the dynamo of car has high rating..... in comparison with other dc dynamo generator, so it creates a strong electro-magnetic field inside the coil of generator. Finally this electro-magnetic field oppose the direction of rotation of the rotor and user gets hard to paddle the cycling machine.

6.1.2. Solutions:

In order to solve this problem we need to reconstruct the whole process which is not possible at this moment. So we have find out some observation for this particular problem which may be implemented in the project for further research. First of all we need to set the dynamo generator at the back side of the cycling machine. It will balance both the bottom line and topside pressure of the chain. This might also helps to avoid limited amount gravitational force in some extent. The user will feel less roughness in the case of paddling. We might avoid displacement and overlapping of both chains and also could get rid of that unusual sound.

To fix this problem we did some research and find a solution. We can delete this problem by using a dc generator rather than using dynamo of car. It has rpm of 1800- 3900 which is much required for this machine. This gives 12-24 volt. Again this dc generator is consists of permanent magnet which limits the additional electro-magnetic field. So it will become much easier for the user to paddle the cycling machine. But we cannot apply that dc generator in our project due to its high cost and unavailability.

6.2. In case of Chair:

6.2.1. Limitations:

In the chair model we have used a rectangular shaped frame. Inside the frame we used four bearing which were adjusted to the frame by welding. Throughout the welding process free balls inside the bearings were little bit damaged. For this reason the linear stick we used for moving on the circular disk towards both directions gets stuck due to some friction. As a result we suffered from getting desired rotation and lost some power.

Another limitation is that we used human accessorize belts. During the circulations these belts are displaced frequently from the circular disk which disturbs the whole rotational process. So we felt troubles during the measurement of rotation.

6.2.2. Solutions:

In order to eradicate these problem we have be careful in the time of fabrication. In case of welding we have use more eligible manpower to avoid this situation. Again we can use belts made from tire or cycle tube. It will help us to count the number of rotation and also help to complete the whole circulation process.

Conclusion:

In the future we are going to work on the green power harvesting by piezoelectric material. And also we upgrade the limitation of the cycle generator and chair generator. However, we also do a project work on the converting more human energy to electric energy.

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